Premiums, Discounts and Feedback Trading:

Evidence from Emerging Markets' ETFs

Abstract

This study investigates the extent to which ETFs' premiums and discounts motivate feedback trading in emerging markets' ETFs. Using a sample of the first-ever launched broad-index ETFs from four emerging markets (Brazil, India, South Africa and South Korea), we produce evidence denoting that feedback trading grows in significance in the presence of lagged premiums. The significance of feedback trading becomes more widespread across our sample's ETFs as the lagged premiums grow in magnitude, with evidence also suggesting that the effect of lagged premiums over feedback trading varies prior to and after the outbreak of the recent global financial crisis.

Keywords: feedback trading; exchange-traded funds; emerging markets

JEL classification: G02, G10, G15, G23

Introduction

Research on the behaviour of investors in exchange-traded funds (ETFs, hereafter) has indicated that they are prone to pursuing feedback strategies, the latter having been linked to a variety of behavioural factors including overreaction (Madura and Richie, 2004), market sentiment (Chau et al, 2011) and herding (Chen et al, 2012). It is worth noting however, that the previous studies have focused on the US market and that little is known about investors' behaviour in emerging market ETFs. Another interesting issue here is whether ETFs' premiums/discounts (i.e. the observed deviations of ETF-prices from their underlying net asset values – NAV, hereafter) also bear an effect over the observed feedback trading in ETFs and whether this effect changes following the onset of the recent financial crisis. It is the above issues that our study aims at investigating.

To begin with, ETFs have evolved phenomenally as an innovation in international equity markets since the 1990s[1], with the global ETF-industry totalling 8,143 funds and a combined market value of almost $12 trillion by year-end 2013[2]. The key feature of ETFs is that they combine elements of both open- and closed-end funds; they are both capable of tracking a benchmark-index (like open-end funds) as well as being traded in equity markets (like closed-end funds), thus allowing their investors the opportunity to trade an index[3] through a single tradable instrument. Aside from their trading in the secondary market, there also exists a primary market for them, whereby authorized participants (such as institutional investors or market makers) can perform in-kind creation or redemption of ETF-units[4]; furthermore, ETFs allow investors to engage in equity trading practices, including short-selling, margin trading and stop-loss orders. Owing to their unique features (including tax-efficiency, low management fees, dividend-treatment, transparency and risk-diversification; see

[1] The first ETF was launched in Canada under the name TIPs (Toronto Index Participation units) in 1989 with the purpose of tracking the Toronto 35 Index. However, it was in the US that ETFs gained in popularity through the American Stock Exchange (AMEX) which initially dominated their listings in the 1990s. The first ETF was launched in the US in 1993 with the purpose of tracking the S&P 500 index and came to be known as "Spiders" (SPDRs: Standard & Poor's 500 Depositary Receipts; ticker symbol SPY).

[2] Source: World Federation of Exchanges (2013).

[3] The benchmark-index may relate to equities, bonds, currencies, commodities, or sectors, among others.

[4] Unit-creation involves creating ETF-shares by borrowing batches of shares (normally from investment trusts), deposit them with the ETF's management company (alongside an amount of cash) and obtain ETF-shares; unit-redemption involves authorized participants returning their in-kind created ETF-units and receiving the deposited batch of stocks (plus a cash-amount). The cash-amount mentioned here is necessary to cover any discrepancy between the ETF's NAV and the value of the basket of stocks necessary to form an ETF-unit. Cherry (2004) has estimated that a range of 25,000 to 600,000 shares are needed to be deposited by authorized participants to obtain a single creation-unit in an ETF in the US.

Deville, 2008 for a detailed discussion), ETFs have traditionally enjoyed wide popularity with the institutional investment community as portfolio- and risk-management instruments (Ünal, 2009; Hill and Teller, 2010) and have been attracting increasing numbers of retail investors as an alternative to mutual funds (Ellis, 2009; Nedeljikovic, 2011; Flood, 2012).

The popularity of ETFs has motivated research on investors' behaviour in this segment; although this area of research is still in its early stages, evidence suggests ETFs are particularly susceptible to feedback trading. Feedback trading *per se* relates to investment strategies based on historical prices (De Long et al, 1990), including momentum trading (Jegadeesh and Titman, 2001), contrarian trading (De Bondt and Thaler, 1985), technical analysis (Lo et al, 2000), stop-loss orders (Osler, 2005), portfolio insurance (Luskin, 1988) and margin trading (Watanabe, 2002; Hirose et al, 2009). In the context of ETFs, Madura and Richie (2004) showed that US ETFs during the dot com bubble were prone to intraday price-overreaction and -correction that could be profitably exploited by contrarian (negative feedback[5]) day-traders. Chau et al (2011) reported evidence showing that positive feedback trading[6] in the three largest US ETFs (Spiders; Cubes[7]; Diamonds[8]) grew in significance during periods characterized by optimistic market sentiment and up-market trends. Chen et al (2012) explored the trading patterns of institutional investors in the US ETF market and documented the presence of contrarian trading tendencies among them, alongside significant herding, the latter being mainly observed for ETFs of smaller size. The reasons why ETF-investors are susceptible to feedback trading vary, depending on the type of investor involved. Several feedback-style strategies, such as portfolio insurance, margin trading and stop-loss orders are typically performed by institutional investors using ETFs (Ünal, 2009) for purposes, such as hedging (to protect against declines in the ETF's underlying index; see Curcio et al, 2004), tactical portfolio allocation (to gain instant asset-class exposure or shift between asset-classes) and core-satellite strategies[9]. Regarding retail investors, the

[5] Negative feedback (or "contrarian", as is more popularly known) trading involves investors buying (selling) when prices fall (rise), i.e. bucking the trend.
[6] Positive feedback (popularly known as "momentum") trading is the case whereby investors trend-chase by buying (selling) when prices rise (fall).
[7] The ETF linked to the NASDAQ100 index, launched in March 1999 (ticker symbol: QQQQ).
[8] The ETF linked to the Dow Jones Industrial Average index, launched in January 1998 (ticker symbol: DIA).
[9] A core-satellite strategy combines passive investment instruments (the "core", which may include benchmarked assets, such as ETFs, index futures etc) with a portfolio of individual assets (the "satellite", including selected

very design of ETFs can appeal to a series of behavioural forces (recognition heuristic; familiarity bias; ambiguity aversion; limited attention) which can lead them to feedback trade by boosting their overconfidence[10]. Motivated by the forgoing discussion, we formally present the first hypothesis of this paper:

Hypothesis 1: There exists significant feedback trading in emerging markets' ETFs.

Another factor capable of giving rise to feedback-style strategies in ETFs is their observed premiums and discounts, reflected through the deviations between their price and their NAV. Since the value of the assets an ETF invests into comprises its fundamental value, the law of one price would suggest that for its pricing to be efficient, its price should largely be in line with its NAV; should deviations between the two exist, this would indicate the presence of an inefficiency largely similar to the closed-end fund puzzle (see e.g. Lee et al, 1991), where closed-end funds have been found to be trading at a discount relative to their NAV. Although Deville (2008)

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stocks, bonds etc); the purpose of such a strategy is to build a portfolio (the "core-satellite" one) with desired risk-return features.

[10] The **recognition heuristic** (Boyd, 2001) posits that investors evaluate more positively assets that are easier for them to recognize compared to others which are not. An ETF, for example, linked to the S&P500 index (such as the SPDR mentioned in an earlier footnote) would, on average, be more "recognizable" to retail traders compared to a fund investing in any particular combination of S&P500-constituents (it is unlikely an investor can recognize all 500 names of the constituents of that index). However, if an asset is easier to recognize, it also generates a greater sense of familiarity. If the average US retail investor cannot recognize all 500 S&P500-constituents, it is doubtful he feels familiar with all of them either. What is more, it is highly unlikely that each and every one of these 500 stocks will receive equal daily coverage on the news; conversely, the S&P500-values would be reported on the news on a daily basis. Consequently, an S&P500-linked ETF would emit an enhanced sense of **familiarity** (Huberman, 2001) to retail investors, since it would invest not just in any basket (whose selection-criteria may be based on a strategy the investor may not fully comprehend) but in the specific basket of the market's main index. Another issue here is that the concept of portfolio-diversification entails ambiguity for retail investors who are less sophisticated, possess less investment experience and have fewer resources at their disposal than their institutional counterparts and this is reflected in the under-diversification often characterizing their portfolios (Barberis and Huang, 2001). An ETF can help remove this ambiguity by allowing them instant exposure to the portfolio of a sector or the market as a whole. What is more, an ETF removes the ambiguity in terms of performance, since it is bound, by design, to track the performance of its underlying index. Consequently, an investor who does not feel particular confidence in his portfolio-building skills and wishes to invest in a particular market or sector would view investing in an ETF linked to that market/sector more favourably as a means of **ambiguity aversion**. Following on from that, **limited attention** (Hirshleifer and Teoh, 2003; Hirshleifer et al, 2011) - which refers to the situation where individuals' attention is unable for some reason to capture all elements of a multifaceted issue – is relevant here. An investor holding a portfolio trying to replicate the performance of a market's index will have to regularly monitor the performance of his stocks, compare it to some pre-determined point in the past and rebalance his portfolio according to each stock's performance and the performance of the index itself. Conversely, holding an ETF linked to that index reduces the above procedure to the comparison of the index versus a single asset – the ETF. If ETFs enhance familiarity and simplification in the trading process, one would expect retail ETF-investors' **overconfidence** (Barber and Odean, 2000; Barber et al, 2008; Barber et al, 2009) to be boosted, as they would underestimate the probability of realizing losses (something further encouraged by the fact that less trading costs will be incurred when trading the ETF alone rather than the constituents of its underlying index) and render them more susceptible to trend-chasing.

has argued that the in-unit creation/redemption would be expected to deter such deviations by allowing institutional investors to arbitrage the price discrepancy away, evidence on this issue is rather mixed, with some studies advocating ETFs' pricing efficiency (Ackert and Tian, 2000; Elton et al, 2002; Curcio et al, 2004) and others documenting the presence of significant deviations (Simon and Sternberg, 2004; Fujiwara, 2006; Harper et al, 2006; Kayali, 2007; Rompotis, 2010; Shin and Soydemir, 2010; Blitz and Huij, 2012). Similar to closed-end funds[11], research (Cherry, 2004; Jares and Lavin, 2004) has confirmed that premiums and discounts in ETFs can be profitably exploited by *ad hoc* trading strategies. Given that these strategies are essentially feedback-style in nature (they aim at timing investment in an ETF by observing the deviations of its price from its NAV over time), it would be reasonable to assume that such deviations can motivate feedback trading in ETFs. This leads us to the second hypothesis of this paper:

Hypothesis 2: There is a positive relation between the significance of feedback trading and premiums/discounts in emerging markets' ETFs.

Finally, we also examine whether there exists significant time-variation in the impact of premiums/discounts on feedback trading in emerging markets' ETFs. Intuitively, following the onset of a financial crisis, any price deviation tends to be rather persistent as the inefficiency is less likely (or more difficult) to be arbitraged away in adverse market conditions. Such a scenario can then push prices further away from fundamentals and possibly exacerbate investors' irrationality. Therefore, one can expect the effect of ETFs' premiums/discounts on feedback trading to be more pronounced during crisis periods[12]. This leads us to our third hypothesis:

Hypothesis 3: The effect of ETF premiums/discounts on feedback trading is most evident in the periods following the outbreak of a financial crisis.

[11] See e.g. Hughen et al (2005).

[12] This expectation is also supported by the empirical evidence of Bohl et al (2014) who documented that the short-selling restrictions imposed during the recent global financial crisis has increased the uncertainty among stock market investors and induced the adverse herding in stock markets.

The central goal of the current paper is to test the hypotheses developed above by using a sample of the first-ever launched broad-index ETFs from four emerging markets (Brazil, India, South Africa and South Korea). Our focus on emerging markets was driven by four reasons. First of all, the study of ETF investors' behaviour in general and feedback trading in particular has been confined to date in US ETFs, with no evidence being available on other markets. Secondly, investors in emerging markets are likely to be attracted to feedback trading strategies when investing in ETFs given that they have been found to be more susceptible to behavioural patterns[13] in their equity-trading compared to their peers in developed markets. Thirdly, stocks in emerging markets are more likely to face issues of stale pricing (due to their relatively lower volumes and higher trading costs) compared to developed markets, thus rendering premiums and discounts more likely in ETFs as a result of a) delays in the in-kind creation/redemption of ETF units[14] and b) their NAV not being able always to include all information reflected in ETFs' closing prices[15]. Fourthly, the first-ever launched broad-index ETFs of these specific four markets were chosen also because they were among the very first ETFs ever to have been launched in emerging markets in general.

More specifically, our research seeks to address the following questions:

- Is feedback trading significant in emerging markets' ETFs?
- Do the observed premiums/discounts exert an effect over feedback trading in emerging markets' ETFs?
- Does this effect exhibit differences between pre- and post-crisis periods?

In summary, our results indicate that, estimated unconditionally, there exists no significant feedback trading in our sample ETFs. However, when conditioning feedback trading upon the observed lagged premiums/discounts, it exhibits significance in the presence of lagged premiums (i.e. when the ETF traded at a price

[13] For example, Chang et al (2000) showed that emerging markets are more prone to herding than developed ones.
[14] If some stocks among the constituents of an index exhibit thinness in their trading, an authorized participant might have issues in trading the underlying basket of stocks of that index in order to create/redeem ETF-units.
[15] If the stocks making up an index-basket do not see their prices change as frequently as the index, then at any point in time the NAV of the ETF benchmarked to that index will include past valuations for some stocks (e.g. a stock that last traded a week ago will see its market value unchanged for a week and that same market value will be used in the calculation of the ETF's NAV every day for the past week). Whereas the ETF's closing prices will change every day to incorporate investors' beliefs that reflect new information, its NAV will (to the extent that some of the underlying basket's stocks will not trade every day) not be able to do so, since part of its calculation will rest on stock-valuations of previous days.

in excess of its NAV the day before). This significance becomes more widespread among ETFs as the observed lagged premium grows in magnitude, yet appears sensitive to the period chosen; the bulk of feedback trading significance is detected following the global financial crisis' outbreak for the South Korean ETF and prior to its outbreak for the other three ETFs. Our research produces the following two contributions to the extant literature on ETFs. First of all, unlike previous studies (Madura and Richie, 2004; Chau et al, 2011; Chen et al, 2012) focusing on US ETFs, it investigates for the first time feedback trading in emerging markets' ETFs, thus yielding novel insight in ETF-investors' behaviour for a market-category considered to be more susceptible to behaviourally biased trading than developed markets. Secondly, it depicts for the first time the effect of ETFs' premiums/discounts over the significance of their feedback trading, showing that feedback trading in ETFs entails complex dynamics and should not be viewed as a behavioural pattern simply based on past returns. The rest of our study is organized as follows: the next section provides a detailed presentation of the empirical design and the data employed; we then present and discuss the results and provide our concluding remarks.

Data and Methodology

Our sample data includes daily observations on the closing prices, the net asset values and the percentage price deviations from the net asset value[16] for the first-ever launched broad-index ETFs of four emerging markets, namely Brazil (PIBB IBRX-50 index fund), India (NIFTY BEES), South Africa (SATRIX 40) and South Korea (KOSEF 200). All data for the four ETFs were obtained from their respective asset management companies[17] and are expressed in the currency of each ETF's home-country; the start-date for each ETF is its launch-date (PIBB IBRX-50 index fund: 26/7/2004; NIFTY BEES: 8/1/2002; SATRIX 40: 30/11/2000; KOSEF 200: 14/10/2002) while the end-date is 7/12/2012.

[16] For robustness, we have also run our estimations with these deviations calculated as the logarithm of the ETF's closing price minus the logarithm of its NAV; results are essentially identical irrespective of the specification used.

[17] The asset management companies involved are Banco Itaú (PIBB IBRX-50 index fund), Goldman Sachs Mutual Fund (NIFTY BEES), Satrix Managers (Pty) Ltd. (SATRIX 40) and Woori Asset Management Company Ltd. (KOSEF200).

Descriptive statistics for the daily log-differenced returns of our sample ETF-series are presented in table 1 (panel A), from where it is evident that our ETF return-series exhibit departures from normality; this is initially denoted by the fact that all four of them are found to be significantly (1 percent level) leptokurtic. The Brazilian, Indian and South Korean ETFs are also characterized by significant (1 percent level) negative skewness, while the significant (1 percent level) Jarque-Bera test statistics further confirm the absence of normality in the distributions of all four return-series. The documented non-normality could be the product of temporal dependencies in the first-moment of the series; the Ljung-Box test-statistics are significant for all ETF series[18], suggesting that such dependencies do exist (possibly due to market frictions, such as non-synchronous trading). It is, however, possible that the presence of significant feedback trading can lead to autocorrelations of higher order; to that end, we implement the Ljung-Box test on squared ETF returns. Results from this test exhibit significance (1 percent level) and are significantly higher than the Ljung-Box statistics calculated for ETF returns, confirming the presence of higher moment temporal dependencies in our ETFs' distributions.

Panel B presents the summary statistics on the distribution of positive (premiums) and negative (discounts) percentage price deviations of the ETFs from their net asset values, while panel C provides statistics on the distribution of the day-to-day changes in those deviations. It is interesting to note that our sample ETFs trade at a discount in the majority of their trading days (85% for the Brazilian ETF; 59% for the Indian ETF; 61% for the South African ETF; 74% for the South Korean ETF), and very often these discounts are in excess of 0.5%. This is largely consistent with evidence of ETF premiums/discounts observed for those ETFs being traded outside the U.S. market. For example, Jares and Lavin (2004) find frequent and sizable premiums/discounts for the ETFs in Japan and Hong Kong, representing profitable trading opportunities[19]. Thus, as discussed in the introduction, it is interesting and informative to investigate whether the ETF-investors' trading behaviour is related to

[18] At the 1 percent level, with the exception of the Ljung-Box test statistic for the South Korean ETF which is significant at the 10 percent level.

[19] While it is beyond the scope of this paper, it will be interesting in future work to understand better the reasons why the mispricing (or price discrepancy) may arise and persist in the ETF markets. A number of sources (e.g., dividend, illiquidity, size, and measurement error) have been put forward in explaining the frequent and sizable deviations between ETF prices and their NAVs, but there is a lack of consensus in the extant literature. See, e.g., Jares and Lavin (2004), Engle and Sarkar (2006), and Shin and Soydemir (2010).

the ETFs' premiums and discounts, and whether this relation varies across the pre- and post-crisis periods.

Our empirical design is based on the framework proposed by Sentana and Wadhwani (1992), according to which there exist two types of traders, rational speculators and feedback traders. Rational speculators aim at maximizing their expected mean-variance utility in the following demand function:

$$Q_t = \frac{E_{t-1}(r_t) - \alpha}{\theta \sigma_t^2} \tag{1}$$

where Q_t reflects the fraction of the ETF's shares demanded by them, $E_{t-1}(r_t)$ is the expectation of the ETF's return for period t given the information at period t-1, α is the risk-free rate of return, θ is the coefficient of risk-aversion and σ_t^2 is the conditional variance at period t.

Feedback traders' demand is based on the historical price-sequence and their demand function is given as:

$$Y_t = \gamma\, r_{t-1} \tag{2}$$

Equation (2) indicates that feedback traders condition their trading on the previous period's return (r_{t-1}). In particular, positive feedback traders buy after a price rise and sell after a price fall (γ>0), while negative feedback traders buy when the price is low and sell when the price is high (γ<0) which is consistent with the behaviour of those investors following 'buy low/sell high' strategies. In equilibrium, the coexistence of rational speculators and feedback traders implies that all shares must be held:

$$Q_t + Y_t = 1 \tag{3}$$

$$E_{t-1}(r_t) = \alpha - \gamma r_{t-1}\, \theta\, \sigma_t^2 + \theta\, \sigma_t^2 \tag{4}$$

Assuming the rational expectation [$r_t = E_{t-1}(r_t) + \varepsilon_t$] and replacing the conditional expected return with the realized return and a stochastic error term, equation (4) can be rewritten as:

$$r_t = \alpha - \gamma r_{t-1}\, \theta\, \sigma_t^2 + \theta\, \sigma_t^2 + \varepsilon_t \tag{5}$$

Equation (5) denotes that the first-order autocorrelation of returns varies with risk in the market, σ_t^2 (as indicated by the term $\gamma r_{t-1}\, \theta\, \sigma_t^2$), while its sign depends on the prevailing sign of feedback trading, γ (positive feedback trading leads to negative return autocorrelation, and vice versa). An issue arises, however, with the extent to which the autocorrelation observed is due to feedback traders or extant market frictions, caused by for example non-synchronous and thin trading. To that end, Sentana and Wadhwani (1992) proposed the following specification of equation (5):

$$r_t = \alpha + \theta\sigma_t^2 + \left(\phi_0 + \phi_1\sigma_t^2\right)r_{t-1} + \varepsilon_t \tag{6}$$

In the above equation, the effect of market frictions is captured through ϕ_0, while ϕ_1 captures the presence of feedback trading. Since $\phi_1 = -\theta\,\gamma$, this suggests that if ϕ_1 is positive (negative) and statistically significant, negative (positive) feedback traders are dominant in the market.

To examine the influence of premiums/discounts on feedback trading behaviour in our sample ETFs (i.e., Hypothesis 2), we extend the empirical version of the Sentana and Wadhwani (1992) model proposed by Chau et al. (2011) to allow the demand of feedback traders to be affected by the observed premiums/discounts as follows:

$$Y_t = [\gamma D_t + \lambda(1 - D_t)]r_{t-1} \tag{7}$$

In equation (7), D_t is a dummy variable whose value equals one if a given premium/discount occurred in period t-1 and zero otherwise[20]. Equation (7) assumes that feedback trading in this case varies with the observed premium/discount, thus indicating that the previous period's ETF's price and its deviation from its net asset value at that period are used interactively by feedback traders. If equation (7) holds, equation (5) will become:

$$r_t = \alpha + \theta\,\sigma_t^2 - [\gamma D_t + \lambda(1 - D_t)]\theta\,\sigma_t^2\, r_{t-1} + \varepsilon_t \tag{8}$$

Equation (6) can now be modified as follows:

$$r_t = \alpha + \theta\sigma_t^2 + D_t\left(\phi_{0,0} + \phi_{1.0}\sigma_t^2\right)r_{t-1} + (1 - D_t)\left(\phi_{0,1} + \phi_{1.1}\sigma_t^2\right)r_{t-1} + \varepsilon_t \tag{9}$$

[20] The reason for using the lagged premiums/discounts is that it is unlikely that contemporaneous ETFs' premiums/discounts affect feedback traders' demand; given that the daily ETF net asset values are reported following the end of each trading session, it would be impossible to trade on this information on the same day.

To empirically estimate equation (9), we define the conditional variance as an asymmetric GARCH process (Glosten et al, 1993):

$$\sigma_t^2 = \omega + \beta\,\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2 \tag{10}$$

In the above equation, δ captures the asymmetric responses of volatility following positive versus negative shocks. S_{t-1} is a binary variable, taking the value of one if the shock at time t-1 is negative and zero otherwise; a significantly positive value for δ indicates that negative shocks increase volatility more than positive ones.

Our sample window includes the period following the outbreak of the recent global financial crisis; given the importance of this event for global markets, it is necessary to examine its effect over our results. To empirically test our conjecture (i.e., Hypothesis 3) that the effect of ETF premiums/discounts on feedback trading is most evident in the periods following the outbreak of a financial crisis, we split our sample window into a pre (up to August 31st, 2008) and a post (September 1st, 2008[21] – December 7th, 2012) crisis-outbreak period and repeat our estimation of equations (9) and (10).

Results and Discussion

Table 2 presents the estimation results for equations (6) and (10), i.e. the original Sentana and Wadhwani (1992) model. As the estimates from the conditional mean equation suggest, none of the four ETFs accommodated significant feedback trading during our sample period (ϕ_1 is found to be insignificant for all of them), while they also appear to be unaffected by the presence of market frictions (the sole evidence of significant ϕ_0 is reported for the Brazilian ETF for the 10 percent level of significance). These results appear to reject Hypothesis 1. They also contrast with the evidence of Chau et al (2011) who concluded that there was significant feedback trading in the three largest ETFs (Spiders; Cubes; Diamonds) in the U.S. The differences in results for the U.S and emerging ETF markets allow us to argue that the ETF-investors in emerging markets may not exhibit the same behavioural pattern

[21] The identification of the crisis-outbreak with September 2008 is motivated by the confluence of events during that month in the US (including Lehman Brothers filing for bankruptcy and the federal government taking over Freddie Mac and Fannie May) that led the crisis to turn global. See Ivashina and Scharfstein (2010).

in their equity-trading as their peers in the developed markets, maybe because of the dissimilarities in their contract design and market microstructure[22]. Regarding the conditional variance, it is found to be significantly persistent and asymmetric (λ and δ are significantly positive at the 1 percent level for all ETFs). The significant persistence of volatility is further illustrated by the values of volatility half-life calculated as HL=ln(0.5)/ln(β+λ+δ/2) (see Harris and Pisedtasalasai, 2006); as these values indicate, the effect of a shock upon each of these ETFs' volatility lasts anywhere between 17 and 30 days. Regarding volatility asymmetry, its presence is confirmed for all four ETFs by calculating their asymmetric ratios, all of which generate values above unity[23]. The β coefficient appears significant for the Indian and South Korean ETFs indicating that news has a significant impact on their price-volatility; this is not found to be the case with the Brazilian and South African ETFs. Taken together, the coefficients describing the conditional variance process, ω, β, λ, and δ are not unusual, and are largely in line with the results of Antoniou et al (2005) documented for the stock index futures and Chau et al (2011) for the US ETFs.

We now turn to the focus of this paper and consider the effect of observed premiums/discounts over the estimated feedback trading (i.e., Hypothesis 2). To that end, we use the daily percentage price deviations of each ETF from its net asset value to define the dummy variable in equation (9); we begin by setting $D_t = 1$ when the ETF traded at a discount during the previous day (and zero if it traded at a premium)[24] and present results in table 3. Rejecting Hypothesis 2, our results indicate the absence of a significant relation between feedback trading and ETFs' lagged premiums/discounts for three of our four ETFs. The only exception is the South Korean ETF, whose $\phi_{1,1}$ coefficient appears significantly (5 percent level) negative, indicating the presence of significant positive feedback trading when the ETF exhibits a lagged premium. No evidence of significant first-order autocorrelation is detected, with $\phi_{0,0}$ and $\phi_{0,1}$ being both insignificant for all ETFs. When we formally test for the hypotheses $\phi_{0,0}=\phi_{0,1}$ and $\phi_{1,0}=\phi_{1,1}$, we find that neither is rejected for our four ETFs. All estimates of the conditional variance equation are in line with the

[22] A further examination of why such differences might exist is worthy of a study, but is beyond the scope of this paper. We thank the anonymous reviewer for the suggestion.
[23] The asymmetric ratio is calculated here as (β+δ)/ β (see Antoniou et al, 2005).
[24] The reason why we set the dummy variable equal to one for discounts is that our sample ETFs trade at a discount for the majority of trading days (see table 1).

results from table 2, implying the presence of highly persistent and asymmetric volatility.

The above estimations aimed at assessing the impact of the sign of ETFs' lagged tracking error (i.e. whether an ETF exhibits a lagged premium or discount) over feedback trading, yet do not take into account the magnitude of this error. To address this issue, we first condition feedback trading upon the observed **level** of the lagged premium/discount, setting D_t equal to one for several premium (percentage price deviations ≥ 0.25%, 0.5%, 0.75% and 1%) and discount (percentage price deviations ≤ -0.25%, -0.5%, -0.75% and -1%) levels. Results are presented in table 4; for brevity, only the estimates of $\phi_{1,0}$ and $\phi_{1,1}$ are reported. As the table indicates, evidence of significant feedback trading arises for the Indian and South Korean ETFs for various lagged premium levels. More specifically, $\phi_{1,0}$ is positive and significant (5 percent level) for the Indian ETF when its lagged percentage price deviation is ≥ 0.75% and ≥ 1%, suggesting there exists significant negative feedback trading in that ETF when it exhibits a lagged premium well above its sample period's average premium (0.42%), although the hypothesis $\phi_{1,0} = \phi_{1,1}$ cannot be rejected. Regarding the South Korean ETF, it furnishes us with evidence of significant positive feedback trading when its lagged percentage price deviation is ≥ 0.25% and significant negative feedback trading when its lagged percentage price deviation is ≥ 0.5% and ≥ 1%. Combined with the results reported in table 3, these estimates suggest that the presence of lagged premiums in this ETF triggers significant feedback trading, which switches from positive to negative as the magnitude of the lagged premium rises. The hypothesis $\phi_{1,0} = \phi_{1,1}$ is rejected for all cases where the South Korean ETF exhibits significant feedback trading. Interpreted within the context of an asset pricing model with heterogeneous market participants, these parameter values reveal an interesting result that positive feedback trading is higher in the presence of significant premium (tracking error), but negative feedback trading dominates as the level of premium rises above certain thresholds. This is consistent with the view that some arbitrageurs (negative feedback traders) tend to 'jump on the bandwagon' themselves before eventually selling out near the top and take their profit, leading to the short-term momentum and long-term reversal phenomenon (Antoniou et al.

2005). Although eventually arbitrageurs sell out and help prices return to fundamentals, in the short run they feed the 'bubble' rather than help it to dissolve.

When we perform separate estimations for the periods before and after the global financial crisis' outbreak, we document evidence of feedback trading significance for all four ETFs, with this significance being clustered post crisis-outbreak for the South Korean ETF (consistent with Hypothesis 3) and pre crisis-outbreak for the rest three ETFs, as table 5 indicates. Starting with the South Korean ETF, $\phi_{1,1}$ is significantly negative for the test whereby $D_t = 1$ when the ETF traded at a discount during the previous day (and zero if it traded at a premium) post crisis' outbreak, indicating that during that period, it exhibited significant positive feedback trading when there was a lagged premium (although the hypothesis $\phi_{1,0} = \phi_{1,1}$ cannot be rejected). The $\phi_{1,0}$ coefficient is consistently positive and significant for all tests involving a positive lagged percentage price deviation (≥ 0.25%, 0.5%, 0.75% and 1%) during the same period, suggesting that as the lagged premium rises in magnitude, this ETF starts exhibiting significant negative feedback trading[25]. Interestingly, this ETF exhibits significant negative feedback trading also when its lagged percentage price deviation is ≤-1% during the same period, furnishing us with the initial evidence of feedback trading significance in relation to observed lagged discounts. Regarding the period prior to the outbreak of the crisis, the Indian ETF exhibits significant negative feedback trading ($\phi_{1,0}$>0) for several lagged premium levels (≥0.5%, 0.75% and 1%), while the Brazilian ETF presents us with significant negative feedback trading when its lagged premium is ≥1%; the hypothesis $\phi_{1,0} = \phi_{1,1}$ is rejected in all these cases. The South African ETF also exhibits significant positive feedback trading in the pre crisis' outbreak period when its lagged premium is ≥0.75% and 1%, although the hypothesis $\phi_{1,0} = \phi_{1,1}$ cannot be rejected in this case. These differences between whole- and sub-sample (and between pre- and post- crisis periods) allow us to suggest that relying on the data for the entire period may underestimate the actual extent of feedback trading in the emerging markets ETFs. The need for analysis of an appropriate subsample is highlighted if reliable policy conclusions are to be reached.

[25] The hypothesis $\phi_{1,0} = \phi_{1,1}$ is rejected for all cases, except for the one with the lagged percentage price deviation ≥ 0.25%.

In further analysis, we examine the impact of the magnitude of the lagged premium/discount over feedback trading by assuming the **change** of the percentage price deviation (calculated as the first difference between the deviations on day t and t-1) and setting D_t equal to one for several such differences (>0; ≥ +0.5%, +1%, +2%; ≤ -0.5%, -1%, -2%). Results reported in table 6 include - again for brevity - only the estimates of $\phi_{1,0}$ and $\phi_{1,1}$ and denote the presence of significant feedback trading only for the South Korean ETF for various positive changes in its lagged percentage price deviation (i.e. for cases related to either an increase in the lagged premium or a decrease in the lagged discount). This is the case when the change in the lagged percentage price deviation is >0 (significant positive feedback trading), ≥ +0.5% (significant positive feedback trading) and ≥ +2% (significant negative feedback trading), with the hypothesis $\phi_{1,0}=\phi_{1,1}$ being rejected in the latter case only.

We then perform our estimations again separately before and after the crisis' outbreak and notice (see table 7) the presence of significant feedback trading for various changes in the lagged percentage price deviation for the Indian and South Korean ETFs for the period following the crisis' outbreak only. More specifically, the Indian ETF exhibits significant positive (negative) feedback trading for changes in the lagged percentage price deviation ≤ -2% (≥ +2%), with the hypothesis $\phi_{1,0}=\phi_{1,1}$ being rejected in both cases post crisis' outbreak. The South Korean ETF exhibits significant positive feedback trading during the same period for changes in the lagged percentage price deviation >0 (the hypothesis $\phi_{1,0}=\phi_{1,1}$ is not rejected for this case) and ≥ +0.5% and significant negative feedback trading for changes in the lagged percentage price deviation ≥ +2% (the hypothesis $\phi_{1,0}=\phi_{1,1}$ is rejected for both cases).

Consistent with Hypothesis 2, the results reported in tables 3-7 denote that feedback trading significance is linked to the presence of lagged premiums in our sample ETFs. This is particularly apparent for the South Korean ETF, which has significant feedback trading across various lagged premium levels, both for the full sample period and post crisis' outbreak, with the sign of this feedback trading switching from positive to negative as the size of the premium increases. Taking into account that this ETF generated a premium for 660 out of its 2526 trading days (26% of its sample observations), 540 of which fall within the post-outbreak period, it is evident that the presence of a lagged premium encourages the appearance of feedback trading[26]. Conditioning feedback trading upon the change in the lagged percentage price deviation, we find that the South Korean ETF exhibits significant feedback trading both for the full sample period and the post crisis' outbreak period for various positive change levels (>0; ≥ 0.5%, 2%), with its sign again switching from positive (>0; ≥ 0.5%) to negative (≥2%) as this change grows more positive. These results are consistent with those we obtained using the levels of lagged percentage price deviations (a positive change in the lagged percentage price deviation essentially implies either an increase in the premium or a decrease in the discount), pointing towards a relationship between premiums and feedback trading for this ETF. This is perhaps not surprising as many profitable trading strategies can be designed to time an investment in the ETF markets by observing the deviations of ETF price from its NAV over time (Jares and Lavin, 2004).

The Indian ETF exhibits significant negative feedback trading for higher lagged premium-levels both for the full sample period (≥ 0.75% and 1%) and pre crisis' outbreak (≥ 0.5%, 0.75% and 1%) which correspond to around 13% of its total sample observations (it trades at a premium equal to or greater than 0.5% for 357 out of its 2695 sample trading days). Conditioning feedback trading upon the change in the lagged percentage price deviation, we find that the Indian ETF exhibits significant negative feedback trading post crisis' outbreak only for large positive (≥2%) and negative (≤ -2%) change levels, each corresponding essentially to a small number of observations (43 days in total; see table 1, panel C). The Brazilian ETF exhibits significant negative feedback trading when its lagged percentage price deviation is ≥1% pre crisis' outbreak (corresponding to 72 days, around 3.5% of its total sample observations), while the South African ETF generates significant positive feedback trading pre crisis' outbreak when its lagged percentage price deviation is ≥0.75% and 1% which correspond to around 5.3% of its total sample observations (it trades at a premium pre-outbreak equal to or greater than 0.75% for 157 out of its 3907 sample trading days).

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[26] As mentioned above, this ETF generates significant negative feedback trading when its lagged percentage price deviation is ≤-1% post crisis' outbreak and this constitutes our sole evidence of significant feedback trading being linked to lagged discounts in this paper; however, such deep-discount observations are only evident for eleven trading days during that period.

Overall, the evidence presented in this paper denotes three things. First of all, we have shown that emerging market ETFs accommodate significant feedback trading, whose significance emerges once controlling for its interaction with the ETFs' observed premiums and discounts. This demonstrates that feedback trading in ETFs entails complex dynamics and should not be viewed as a behavioural pattern simply based on past returns. Secondly, supporting Hypothesis 2, we have shown that lagged premiums lead to significant feedback trading in our four emerging market ETFs, with this significance becoming more widespread among them as the observed lagged premium grows in magnitude. This is an interesting finding reported for the first time in the literature and implies that feedback traders become active when the ETF trades "expensively", i.e. its price exceeds its net asset value. It is possible that feedback traders in this case are linked to the sell-side (e.g. because they consider the ETF overpriced), though one should not rule out the possibility that the presence of premiums leads them to buy the ETF in anticipation of the premium widening. Thirdly, in line with Hypothesis 3, it is important to note that the effect of lagged premiums over feedback trading appears to be period-specific (after the crisis' outbreak for the South Korean ETF; before the outbreak for the rest three ETFs), suggesting that crisis-periods bear an effect over the behaviour of ETF-investors which should be accounted for[27].

Conclusion

The present paper examines whether ETFs' percentage price deviations from their NAVs (i.e. their premiums and discounts) motivate feedback trading in emerging markets' ETFs. Using a sample of the first-ever broad-index ETFs launched in four such markets (Brazil; India; South Africa; South Korea), we show that feedback trading is indeed related to these deviations, exhibiting significance near-exclusively in the presence of lagged premiums (i.e. when the ETF's closing price was in excess of its NAV the previous day) of various sizes, with the significance of feedback trading growing more widespread across our sample's ETFs as the lagged premium increases in magnitude. These findings are interesting since they indicate that

[27] Whether the results are due to the crisis or the distribution of premiums in the four ETFs is an open issue. As mentioned above, 540 out of 660 premium observations of the South Korean ETF fall in the period following the crisis' outbreak. Conversely, the distribution of premiums in the other three ETFs is more balanced between the two periods (Brazil: 151 out of 311 premium-observations fall post-outbreak; India: 451 out of 1108 premium-observations fall post-outbreak; South Africa: 487 out of 1176 premium-observations fall post-outbreak).

feedback trading in ETFs entails complexities in its nature and does not necessarily rely on historical returns alone. The presence of this relationship is affected by the period chosen, with the bulk of feedback trading significance being detected post crisis' outbreak for the South Korean ETF and pre-outbreak for the other three ETFs. Taken together, the above results are of particular interest to those investors targeting emerging markets' ETFs, as these help improve their understanding of the trading dynamics; specifically for those investors practicing feedback-style rules (such as technical analysis) on these ETFs, our results denote that the price-NAV deviation can be used as an input to inform their trading.

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Table 1 - Descriptive Statistics

	BRAZIL (PIBB)	INDIA (NIFTYBEES)	SOUTH AFRICA (SATRIX40)	SOUTH KOREA (KOSEF200)
Panel A: Statistical properties of the return-series				
μ	0.0580	0.0624	0.0505	0.0481
σ	1.9846	1.5954	0.0268	1.6260
S	-0.1619***	-0.3913***	-0.0390	-0.2272***
E(K)	6.9269***	7.0252***	2.3906***	8.4439***
Jarque-Bera	4151.4729***	5608.7565***	716.5810***	7526.0628***
LB(10)	33.562***	26.254***	25.138***	17.944*
LB^2 (10)	1465.823***	736.489***	1432.066***	642.962***
Panel B: Properties of percentage price deviations				
Average % price deviation	-0.87%	-0.11%	-0.09%	-0.25%
# days with a premium	311	1108	1176	660
# days with a discount	1762	1587	1814	1866
Average premium	0.43%	0.42%	0.35%	0.24%
Average discount	-1.11%	-0.48%	-0.38%	-0.42%
# days when premium >0.25%	163	638	534	162
# days when premium >0.5%	78	357	249	65
# days when premium >0.75%	51	121	121	36
# days when premium >1%	34	54	71	21
# days when discount < -0.25%	1575	1099	974	944
# days when discount < -0.5%	1334	678	464	516
# days when discount < -0.75%	1072	317	201	314
# days when discount < -1%	826	99	83	190
Panel C: Properties of daily changes in percentage price deviations				
# days when change >0.5%	419	444	451	254
# days when change >1%	158	122	126	85
# days when change >2%	30	19	23	11
# days when change < -0.5%	436	420	435	234
# days when change < -1%	155	137	134	78
# days when change < -2%	22	24	20	14

*** denotes significance at the 1 percent level, ** denotes significance at the 5 percent level, * denotes significance at the 10 percent level; μ = mean, σ = standard deviation, S = skewness, E(K) = excess kurtosis, LB(10), LB^2 (10) = the Ljung- Box test-statistics for returns and squared returns for 10 lags.

Table 2 - Maximum Likelihood Estimates of the Sentana and Wadwhani (1992) Model: ETF Daily Returns

Conditional Mean Equation: $r_t = \alpha + \theta\sigma_t^2 + \left(\phi_0 + \phi_1\sigma_t^2\right)r_{t-1} + \varepsilon_t$

Conditional Variance Specification: $\sigma_t^2 = \omega + \beta\,\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$

Parameters	BRAZIL (PIBB)	INDIA (NIFTYBEES)	SOUTH AFRICA (SATRIX40)	SOUTH KOREA (KOSEF200)
α	-0.0216 (0.7005)	0.1012 (0.0114)	-0.0177 (0.6116)	0.0681 (0.1021)
θ	0.0275 (0.1276)	-0.0115 (0.5698)	0.0381 (0.0460)	-0.0012 (0.9510)
ϕ_0	-0.0550 (0.0681)	0.0126 (0.6304)	0.0002 (0.9929)	-0.0074 (0.7945)
ϕ_1	0.0006 (0.8829)	0.0030 (0.5740)	-0.0030 (0.7122)	-0.0066 (0.2384)
ω	0.1155 (0.0000)	0.0604 (0.0000)	0.0392 (0.0000)	0.0646 (0.0000)
β	0.0136 (0.1545)	0.0652 (0.0000)	0.0060 (0.3252)	0.0363 (0.0000)
λ	0.8968 (0.0000)	0.8674 (0.00000	0.9157 (0.0000)	0.8736 (0.0000)
δ	0.1006 (0.0000)	0.0873 (0.0000)	0.1110 (0.0000)	0.1250 (0.0000)
(β +δ)/ β	8.3970	2.3389	19.50	4.4435
Half-life	17.2884	28.8371	30.0532	24.7658

Parentheses include the p-values.

Table 3 - Maximum Likelihood Estimates of the Sentana and Wadwhani (1992) Model: The effect over feedback trading when the ETF exhibits a lagged discount

Conditional Mean Equation: $r_t = \alpha + \theta\sigma_t^2 + D_t\left(\phi_{0,0} + \phi_{1,0}\sigma_t^2\right)r_{t-1} + (1 - D_t)\left(\phi_{0,1} + \phi_{1,1}\sigma_t^2\right)r_{t-1} + \varepsilon_t$

Conditional Variance Specification: $\sigma_t^2 = \omega + \beta\,\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$

Parameters	BRAZIL (PIBB)	INDIA (NIFTYBEES)	SOUTH AFRICA (SATRIX40)	SOUTH KOREA (KOSEF200)
α	-0.0222 (0.6970)	0.1001 (0.0129)	-0.0227 (0.5199)	0.0676 (0.1025)
θ	0.0284 (0.1239)	-0.0126 (0.5386)	0.0414 (0.0335)	-0.0002 (0.9914)
$\varphi_{0,0}$	-0.0415 (0.2096)	0.0458 (0.2659)	0.0153 (0.6735)	-0.0154 (0.7047)
$\varphi_{0.1}$	-0.1272 (0.1052)	-0.0292 (0.4288)	-0.0184 (0.6977)	-0.0091 (0.8378)
$\varphi_{1,0}$	0.0015 (0.7374)	0.0010 (0.9309)	-0.0136 (0.2213)	-0.0000 (0.9999)
$\varphi_{1,1}$	-0.0039 (0.7219)	0.0056 (0.3500)	0.0125 (0.4605)	-0.0120 (0.0213)
ω	0.1182 (0.0000)	0.0625 (0.0000)	0.0401 (0.0000)	0.0643 (0.0000)
β	0.0119 (0.2245)	0.0637 (0.0000)	0.0054 (0.3622)	0.0371 (0.0000)
λ	0.8958 (0.0000)	0.8650 (0.0000)	0.9153 (0.0000)	0.8741 (0.0000)
δ	0.1041 (0.0000)	0.0934 (0.0000)	0.1118 (0.0000)	0.1227 (0.0000)
$\varphi_{0,0} = \varphi_{0,1}$	0.9970 (0.3180)	1.7660 (0.1839)	0.3180 (0.5728)	0.0111 (0.9161)
$\varphi_{1,0} = \varphi_{1,1}$	0.2098 (0.6470)	0.1337 (0.7146)	1.7187 (0.1899)	0.9075 (0.3408)
(β +δ)/ β	9.7478	2.8816	21.7037	4.3072
Half-life	16.8721	27.8287	29.2737	24.9030

Parentheses include the p-values. $\varphi_{0,0} = \varphi_{0,1}$ and $\varphi_{1,0} = \varphi_{1,1}$ hypotheses-estimates are generated by Wald's test.

Table 4 - Maximum Likelihood Estimates of the Sentana and Wadwhani (1992) Model: The effect over feedback trading of various lagged premium/discount levels

Conditional Mean Equation: $r_t = \alpha + \theta\sigma_t^2 + D_t\left(\phi_{0,0} + \phi_{1.0}\sigma_t^2\right)r_{t-1} + (1 - D_t)\left(\phi_{0,1} + \phi_{1.1}\sigma_t^2\right)r_{t-1} + \varepsilon_t$

Conditional Variance Specification: $\sigma_t^2 = \omega + \beta\,\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$

Parameters	BRAZIL (PIBB)			INDIA (NIFTYBEES)			SOUTH AFRICA (SATRIX40)			SOUTH KOREA (KOSEF200)		
	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$
	-0.0010	0.0016	0.0442	0.0087	-0.0014	0.7433	0.0065	-0.0052	0.2258	-0.333	0.0028	8.9904
$PD_{t-1} \geq +0.25\%$	(0.9340)	(0.7144)	(0.8334)	(0.1671)	(0.890)	(0.3886)	(0.7712)	(0.6119)	(0.6347)	(0.0000)	(0.7536)	(0.0027)
	0.0045	0.0012	0.058	0.0103	0.0000	0.9059	0.0056	-0.0036	0.1112	0.0464	0.0038	5.3409
$PD_{t-1} \geq +0.5\%$	(0.7279)	(0.7823)	(0.8090)	(0.1246)	(0.9971)	(0.3412)	(0.8274)	(0.7197)	(0.7387)	(0.0146)	(0.6224)	(0.0208)
	0.0096	0.0004	0.3319	0.0140	0.0011	1.5312	-0.0043	-0.00115	0.0077	0.0409	0.0031	0.9404
$PD_{t-1} \geq +0.75\%$	(0.5350)	(0.9204)	(0.5646)	(0.0485)	(0.8883)	(0.2159)	(0.8889)	(0.8800)	(0.9299)	(0.3013)	(0.6802)	(0.3322)
	0.0135	0.0003	0.6067	0.0161	0.0010	2.2324	0.0019	-0.0025	0.0151	0.0393	0.0037	14.2027
$PD_{t-1} \geq +1\%$	(0.4151)	(0.9471)	(0.4360)	(0.0230)	(0.8929)	(0.1351)	(0.9553)	(0.7967)	(0.9021)	(0.0000)	(0.5508)	(0.0002)
	-0.0001	0.0032	0.0917	0.0023	0.0041	0.0137	-0.0035	-0.0015	0.0113	-0.0004	-0.0072	0.1887
$PD_{t-1} \leq -0.25\%$	(0.9891)	(0.7409)	(0.7621)	(0.8732)	(0.4766)	(0.9068)	(0.7996)	(0.9033)	(0.9150)	(0.9764)	(0.2330)	(0.6640)
	-0.0002	0.0025	0.0648	0.0016	0.0033	0.0115	-0.0077	0.0028	0.1936	-0.0165	-0.0054	0.0857
$PD_{t-1} \leq -0.5\%$	(0.9615)	(0.7925)	(0.7990)	(0.9194)	(0.5544)	(0.9145)	(0.7213)	(0.7869)	(0.6599)	(0.6584)	(0.3565)	(0.7698)
	0.0008	-0.0005	0.0168	0.0058	0.0021	0.0252	0.0011	0.0010	0.0001	-0.0032	-0.0065	0.0049
$PD_{t-1} \leq -0.75\%$	(0.8638)	(0.9552)	(0.8970)	(0.7960)	(0.6992)	(0.8740)	(0.9694)	(0.9230)	(0.9954)	(0.9452)	(0.2520)	(0.9442)
	-0.0003	0.0029	0.1034	0.0127	0.0022	0.1004	0.0103	0.0001	0.0514	-0.0195	-0.0064	0.0570
$PD_{t-1} \leq -1\%$	(0.9579)	(0.7301)	(0.7478)	(0.6980)	(0.6874)	(0.7513)	(0.8135)	(0.9884)	(0.8206)	(0.7205)	(0.2636)	(0.8113)

PD_{t-1} stands for the percentage deviation of the ETF's closing price of the previous day from its net asset value of that day. Parentheses include the p-values. $\varphi_{1,0}=\varphi_{1,1}$ hypothesis-estimates are generated by Wald's test.

Table 5 - Maximum Likelihood Estimates of the Sentana and Wadwhani (1992) Model: The effect over feedback trading of various lagged premium/discount levels before and after the crisis' outbreak

Conditional Mean Equation: $r_t = \alpha + \theta\sigma_t^2 + D_t\left(\phi_{0,0} + \phi_{1,0}\sigma_t^2\right)r_{t-1} + (1 - D_t)\left(\phi_{0,1} + \phi_{1,1}\sigma_t^2\right)r_{t-1} + \varepsilon_t$

Conditional Variance Specification: $\sigma_t^2 = \omega + \beta\,\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$

Parameters	BRAZIL (PIBB)			INDIA (NIFTYBEES)			SOUTH AFRICA (SATRIX40)			SOUTH KOREA (KOSEF200)		
	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$
Panel A: Pre crisis-outbreak												
$PD_{t-1} < 0$	0.005	0.066	0.221	0.003	0.002	0.001	-0.039	0.014	1.310	-0.010	0.018	0.478
	(0.904)	(0.597)	(0.638)	(0.893)	(0.806)	(0.973)	(0.139)	(0.704)	(0.252)	(0.725)	(0.548)	(0.489)
$PD_{t-1} \geq +0.25\%$	-0.0508	0.0055	0.5109	0.0113	-0.0052	1.4729	0.0229	-0.0348	1.4791	-0.0104	-0.0017	0.0263
	(0.5018)	(0.8479)	(0.4747)	(0.0981)	(0.6762)	(0.2249)	(0.5893)	(0.0993)	(0.2239)	(0.8332)	(0.9447)	(0.8711)
$PD_{t-1} \geq +0.5\%$	0.0013	-0.0017	0.0008	0.0204	-0.0048	3.8325	0.0098	-0.0297	0.5903	0.0079	-0.0009	0.0202
	(0.9900)	(0.9456)	(0.9772)	(0.0017)	(0.6874)	(0.0503)	(0.8365)	(0.1535)	(0.4423)	(0.8936)	(0.9680)	(0.8869)
$PD_{t-1} \geq +0.75\%$	-0.0787	0.0009	0.1179	0.0268	-0.0030	5.9834	-0.1166	-0.0205	1.8541	0.0295	-0.0039	0.1698
	(0.7323)	(0.9745)	(0.7314)	(0.0000)	(0.7865)	(0.0144)	(0.0892)	(0.2985)	(0.1733)	(0.7108)	(0.8623)	(0.6803)
$PD_{t-1} \geq +1\%$	0.8255	-0.0070	4.0427	0.0318	-0.0027	8.2348	-0.1193	-0.0206	1.9939	-0.0046	-0.0001	0.0007
	(0.0438)	(0.7907)	(0.0444)	(0.0000)	(0.8023)	(0.0041)	(0.0799)	(0.2956)	(0.1579)	(0.9774)	(0.9949)	(0.9783)
$PD_{t-1} \leq -0.25\%$	0.0019	-0.0286	0.3211	-0.0031	0.0037	0.1289	-0.0360	-0.0165	0.3158	-0.0196	0.0059	0.3047
	(0.9475)	(0.9475)	(0.5709)	(0.8630)	(0.5882)	(0.7196)	(0.1664)	(0.5057)	(0.5741)	(0.6049)	(0.8190)	(0.5810)
$PD_{t-1} \leq -0.5\%$	0.0067	-0.0168	0.2309	-0.0032	0.0016	0.0556	-0.0089	-0.0291	0.2885	-0.0217	0.0020	0.2217
	(0.8337)	(0.6782)	(0.6308)	(0.8700)	(0.8178)	(0.8137)	(0.7727)	(0.2189)	(0.5912)	(0.6222)	(0.9327)	(0.6378)
$PD_{t-1} \leq -0.75\%$	-0.0060	-0.0040	0.0021	-0.0151	0.0018	0.1837	0.0088	-0.0271	0.6281	-0.0078	-0.0041	0.0038
	(0.8609)	(0.9033)	(0.9634)	(0.6968)	(0.7940)	(0.6682)	(0.8257)	(0.2231)	(0.4281)	(0.8892)	(0.8590)	(0.9509)
$PD_{t-1} \leq -1\%$	-0.0258	0.0063	0.5383	-0.0535	0.0009	0.1489	-0.0139	-0.0201	0.0119	-0.0311	0.0009	0.2182
	(0.4635)	(0.8349)	(0.4631)	(0.7036)	(0.8936)	(0.6996)	(0.7957)	(0.3246)	(0.9132)	(0.6298)	(0.9696)	(0.6404)
Panel B: Post crisis-outbreak												
$PD_{t-1} < 0$	0.002	-0.003	0.193	-0.005	0.011	0.857	-0.002	0.014	0.568	0.002	-0.012	1.216
	(0.579)	(0.805)	(0.660)	(0.722)	(0.270)	(0.355)	(0.860)	(0.453)	(0.451)	(0.857)	(0.020)	(0.270)
$PD_{t-1} \geq +0.25\%$	0.0036	0.0031	0.0014	0.0138	-0.0016	0.5581	0.0088	0.0046	0.0214	0.0324	0.0108	1.4153
	(0.7664)	(0.4852)	(0.9703)	(0.3046)	(0.9187)	(0.4550)	(0.7342)	(0.6993)	(0.8837)	(0.0535)	(0.2233)	(0.2342)
$PD_{t-1} \geq +0.5\%$	0.0064	0.0029	0.0638	0.0138	0.0035	0.2744	0.0278	0.0041	0.4893	0.0337	0.0065	12.0162
	(0.6261)	(0.5040)	(0.8006)	(0.3608)	(0.7826)	(0.6004)	(0.3859)	(0.7308)	(0.4842)	(0.0000)	(0.2701)	(0.0005)
$PD_{t-1} \geq +0.75\%$	0.0108	0.0020	0.2787	0.0204	0.0050	0.1689	0.0596	0.0043	1.2187	0.0318	0.0058	10.9401
	(0.5054)	(0.6361)	(0.5976)	(0.5672)	(0.6449)	(0.6811)	(0.2276)	(0.7038)	(0.2696)	(0.0000)	(0.3685)	(0.0009)
$PD_{t-1} \geq +1\%$	0.0123	0.0021	0.3634	0.0062	0.0057	0.0003	0.0739	0.0037	1.1489	0.0323	0.0056	11.0893
	(0.4575)	(0.6255)	(0.5466)	(0.8565)	(0.4105)	(0.9870)	(0.2590)	(0.7444)	(0.2838)	(0.0000)	(0.3236)	(0.0009)
$PD_{t-1} \leq -0.25\%$	0.0012	0.0066	0.2256	0.0032	0.0105	0.0935	0.0170	0.0044	0.3529	0.0060	-0.0060	0.4754
	(0.7851)	(0.5192)	(0.6348)	(0.8800)	(0.3472)	(0.7598)	(0.3007)	(0.7597)	(0.5525)	(0.7091)	(0.3427)	(0.4905)
$PD_{t-1} \leq -0.5\%$	0.0016	0.0045	0.0676	-0.0024	0.0104	0.2461	0.0140	0.0127	0.0015	-0.0132	-0.0044	1.0603
	(0.7304)	(0.6520)	(0.7949)	(0.9188)	(0.3316)	(0.6198)	(0.6546)	(0.3060)	(0.9692)	(0.1524)	(0.2626)	(0.3032)
$PD_{t-1} \leq -0.75\%$	0.0025	0.0020	0.0020	0.0151	0.0056	0.0632	0.0487	0.0098	0.5894	-0.0317	-0.0046	0.0353
	(0.6059)	(0.8357)	(0.9639)	(0.6779)	(0.5734)	(0.8015)	(0.3278)	(0.4005)	(0.4427)	(0.8249)	(0.4478)	(0.8509)
$PD_{t-1} \leq -1\%$	0.0020	0.0042	0.0420	0.0451	0.0060	1.9385	0.1050	0.0071	1.6803	0.1186	-0.0048	7.1238
	(0.6814)	(0.6411)	(0.8377)	(0.0930)	(0.3621)	(0.1638)	(0.1638)	(0.5262)	(0.1949)	(0.0072)	(0.2694)	(0.0076)

PD_{t-1} stands for the percentage deviation of the ETF's closing price of the previous day from its net asset value of that day. Parentheses include the p-values. $\varphi_{1,0}=\varphi_{1,1}$ hypothesis-estimates are generated by Wald's test.

Table 6 - Maximum Likelihood Estimates of the Sentana and Wadwhani (1992) Model: The effect over feedback trading of various changes in ETFs' lagged percentage price deviations

Conditional Mean Equation: $r_t = \alpha + \theta\sigma_t^2 + D_t\left(\phi_{0,0} + \phi_{1,0}\sigma_t^2\right)r_{t-1} + (1-D_t)\left(\phi_{0,1} + \phi_{1,1}\sigma_t^2\right)r_{t-1} + \varepsilon_t$

Conditional Variance Specification: $\sigma_t^2 = \omega + \beta\,\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$

Parameters	BRAZIL (PIBB)			INDIA (NIFTYBEES)			SOUTH AFRICA (SATRIX40)			SOUTH KOREA (KOSEF200)		
	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$
$\Delta PD_{t-1} \geq 0$	0.0053	-0.0035	0.7669	-0.0005	0.0046	0.2291	-0.0008	-0.0051	0.0581	-0.0160	-0.0003	1.4230
	(0.4923)	(0.5291)	(0.3812)	(0.9460)	(0.54420)	(0.6322)	(0.9481)	(0.6874)	(0.8095)	(0.0040)	(0.9798)	(0.2329)
$\Delta PD_{t-1} \geq +0.5\%$	0.0066	-0.0028	0.7685	0.0120	0.0009	0.3411	0.0066	-0.0045	0.2877	-0.0128	-0.0031	0.8165
	(0.4475)	(0.5968)	(0.3807)	(0.5060)	(0.8799)	(0.5592)	(0.7056)	(0.6879)	(0.5917)	(0.0451)	(0.7077)	(0.3662)
$\Delta PD_{t-1} \geq +1\%$	0.0094	-0.0004	0.6394	0.0088	0.0028	0.1037	0.0155	-0.0023	0.3547	0.0024	-0.0012	0.0704
	(0.3923)	(0.9397)	(0.4239)	(0.6208)	(0.6174)	(0.7475)	(0.5811)	(0.8154)	(0.5514)	(0.8419)	(0.8591)	(0.7907)
$\Delta PD_{t-1} \geq +2\%$	0.0231	0.0006	0.9229	0.0228	0.0034	0.5139	0.0180	-0.0026	0.2821	0.0674	0.0023	65.7202
	(0.3270)	(0.8856)	(0.3367)	(0.3865)	(0.5245)	(0.4735)	(0.6326)	(0.7900)	(0.5953)	(0.0000)	(0.6464)	(0.0000)
$\Delta PD_{t-1} \leq -0.5\%$	-0.0032	0.0055	0.7733	0.0073	0.0012	0.2635	0.0074	-0.0032	0.2372	0.0005	-0.0098	0.3765
	(0.5949)	(0.4380)	(0.3792)	(0.4764)	(0.8445)	(0.6077)	(0.7012)	(0.7644)	(0.6263)	(0.9724)	(0.1595)	(0.5395)
$\Delta PD_{t-1} \leq -1\%$	0.0038	0.0005	0.1289	0.0203	0.0020	1.5539	0.0059	-0.0010	0.0778	0.0015	-0.0083	2.0780
	(0.6029)	(0.9325)	(0.7195)	(0.1486)	(0.7275)	(0.2126)	(0.7993)	(0.9232)	(0.7803)	(0.6916)	(0.1472)	(0.1494)
$\Delta PD_{t-1} \leq -2\%$	0.0028	0.0000	0.0500	0.121	0.0029	0.1211	-0.0479	0.0007	0.5529	-0.0005	-0.0076	0.6967
	(0.8022)	(0.9933)	(0.8231)	(0.6422)	(0.5932)	(0.7278)	(0.4569)	(0.9417)	(0.4572)	(0.9309)	(0.2376)	(0.4039)

ΔPD_{t-1} stands for the day-to-day change in the percentage deviation of the ETF's closing price of the previous day from its net asset value of that day. Parentheses include the p-values. $\varphi_{1,0}=\varphi_{1,1}$ hypothesis-estimates are generated by Wald's test.

Table 7 - Maximum Likelihood Estimates of the Sentana and Wadwhani (1992) Model: The effect over feedback trading of various changes in ETFs' lagged percentage price deviations before and after the crisis' outbreak

Conditional Mean Equation: $r_t = \alpha + \theta\sigma_t^2 + D_t\left(\phi_{0,0} + \phi_{1,0}\sigma_t^2\right)r_{t-1} + (1 - D_t)\left(\phi_{0,1} + \phi_{1,1}\sigma_t^2\right)r_{t-1} + \varepsilon_t$

Conditional Variance Specification: $\sigma_t^2 = \omega + \beta\,\varepsilon_{t-1}^2 + \lambda\sigma_{t-1}^2 + \delta S_{t-1}\varepsilon_{t-1}^2$

Parameters	BRAZIL (PIBB)			INDIA (NIFTYBEES)			SOUTH AFRICA (SATRIX40)			SOUTH KOREA (KOSEF200)		
	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$	$\varphi_{1,0}$	$\varphi_{1,1}$	$\varphi_{1,0}=\varphi_{1,1}$
Panel A: Pre crisis-outbreak												
$\Delta PD_{t-1} \geq 0$	-0.0297	0.0077	0.5202	-0.0162	0.0087	1.2735	-0.0306	-0.0188	0.1045	0.0018	-0.0141	0.1387
	(0.4624)	(0.8153)	(0.4704)	(0.4267)	(0.3787)	(0.2591)	(0.2883)	(0.4402)	(0.7465)	(0.9482)	(0.6684)	(0.7096)
$\Delta PD_{t-1} \geq +0.5\%$	-0.0538	0.0093	1.0116	0.0023	-0.0011	0.0150	-0.0230	-0.0254	0.0021	-0.0001	-0.0063	0.0187
	(0.3271)	(0.7601)	(0.3145)	(0.9334)	(0.8687)	(0.9026)	(0.6295)	(0.2249)	(0.9637)	(0.9991)	(0.7999)	(0.8912)
$\Delta PD_{t-1} \geq +1\%$	-0.0705	0.0017	0.3209	-0.0287	0.0019	0.5613	-0.0105	-0.0208	0.0213	0.0186	-0.0075	0.2160
	(0.5666)	(0.9528)	(0.5711)	(0.4766)	(0.7817)	(0.4537)	(0.8747)	(0.2987)	(0.8841)	(0.7247)	(0.7469)	(0.6421)
$\Delta PD_{t-1} \geq +2\%$	0.2500	-0.0113	0.1526	0.0040	0.0030	0.0003	-0.0722	-0.0180	0.4864	0.0727	-0.0015	0.0738
	(0.7083)	(0.6501)	(0.6961)	(0.9510)	(0.6482)	(0.9872)	(0.3361)	(0.3615)	(0.4855)	(0.7901)	(0.9478)	(0.7859)
$\Delta PD_{t-1} \leq -0.5\%$	0.0037	-0.0035	0.0178	0.0112	-0.0081	1.5155	0.0021	-0.0304	0.6555	0.0056	-0.0073	0.0609
	(0.9339)	(0.9095)	(0.8938)	(0.3954)	(0.4025)	(0.2183)	(0.9488)	(0.1941)	(0.4181)	(0.9051)	(0.7577)	(0.8051)
$\Delta PD_{t-1} \leq -1\%$	0.0057	0.0012	0.0057	0.0170	-0.0021	1.2780	-0.0258	-0.0189	0.0168	0.0055	-0.0036	0.0111
	(0.9168)	(0.9649)	(0.9399)	(0.2979)	(0.7745)	(0.2583)	(0.6041)	(0.3551)	(0.8967)	(0.9477)	(0.8694)	(0.9159)
$\Delta PD_{t-1} \leq -2\%$	0.3270	-0.0074	1.1241	0.0231	-0.0015	0.2941	-0.0396	-0.0171	0.0434	-0.0972	-0.0018	1.1834
	(0.2985)	(0.7595)	(0.2890)	(0.6081)	(0.8294)	(0.5876)	(0.7081)	(0.3908)	(0.8349)	(0.2655)	(0.9122)	(0.2767)
Panel B: Post crisis-outbreak												
$\Delta PD_{t-1} \geq 0$	0.0079	-0.0023	0.9904	0.0225	-0.0110	2.6754	0.0121	-0.0016	0.4223	-0.0153	0.0011	1.4554
	(0.3232)	(0.6798)	(0.3196)	(0.1374)	(0.4110)	(0.1019)	(0.4404)	(0.9175)	(0.5158)	(0.0060)	(0.9230)	(0.2277)
$\Delta PD_{t-1} \geq +0.5\%$	0.0107	-0.0017	1.2338	0.0272	0.0020	0.5797	0.0131	0.0026	0.1947	-0.0480	0.0008	8.3743
	(0.2486)	(0.7496)	(0.2667)	(0.3945)	(0.8428)	(0.4464)	(0.5179)	(0.8470)	(0.6590)	(0.0019)	(0.9314)	(0.0038)
$\Delta PD_{t-1} \geq +1\%$	0.0108	0.0012	0.6254	0.0247	0.0040	0.1587	0.0200	0.0044	0.2068	0.0279	0.0071	0.6341
	(0.3288)	(0.7955)	(0.4291)	(0.6306)	(0.6905)	(0.6903)	(0.5368)	(0.7122)	(0.6493)	(0.3090)	(0.3434)	(0.4258)
$\Delta PD_{t-1} \geq +2\%$	0.0174	0.0024	0.2841	0.1613	0.0055	341.9678	0.0269	0.0029	0.1552	0.1350	0.0043	8.9894
	(0.5382)	(0.5659)	(0.5941)	(0.0000)	(0.4431)	(0.0000)	(0.6539)	(0.7953)	(0.6936)	(0.0019)	(0.3186)	(0.0027)
$\Delta PD_{t-1} \leq -0.5\%$	-0.0026	0.0076	1.0526	-0.0186	0.0128	1.6049	-0.0011	0.0082	0.1411	0.0039	-0.0073	0.3843
	(0.6605)	(0.2897)	(0.3049)	(0.3717)	(0.2866)	(0.2052)	(0.9613)	(0.5041)	(0.7072)	(0.8132)	(0.1834)	(0.5353)
$\Delta PD_{t-1} \leq -1\%$	0.0018	0.0024	0.0042	0.0100	0.0087	0.0019	0.0028	0.0069	0.0232	0.0015	-0.0060	1.2625
	(0.8128)	(0.2312)	(0.9486)	(0.7168)	(0.4049)	(0.9657)	(0.6019)	(0.5570)	(0.8789)	(0.8232)	(0.2348)	(0.2612)
$\Delta PD_{t-1} \leq -2\%$	-0.0024	0.0023	0.1114	-0.0942	0.0106	9.5080	-0.0127	0.0070	0.0294	0.0010	-0.0058	0.7290
	(0.8541)	(0.6334)	(0.7385)	(0.0027)	(0.1604)	(0.0020)	(0.9113)	(0.5381)	(0.8639)	(0.8682)	(0.3210)	(0.3932)

ΔPD_{t-1} stands for the day-to-day change in the percentage deviation of the ETF's closing price of the previous day from its net asset value of that day. Parentheses include the p-values. $\varphi_{1,0}=\varphi_{1,1}$ hypothesis-estimates are generated by Wald's test.